

CASCADE LASER CORPORATION

Thermal Image Plate for CO₂ and other molecular lasers Product Information



Figure 1: *Thermal Image Plates*

Theory of Operation

The Thermal Image Plate displays an IR laser beam through the use of thermal-sensitive phosphors. When illuminated these phosphors fluoresce by a long wavelength ultraviolet light (3600Å). The intensity of the fluorescence decreases with increasing temperature. When an IR laser beam strikes the thermal-sensitive surface, the absorbed energy raises the surface temperature and produces a corresponding thermal image. The produced pattern appears as a dark image on a bright fluorescent background when the surface is illuminated by an ultraviolet light. Different sensitivity ranges are obtained by using different phosphors and by varying the amount of thermal insulation between the phosphors and the anodized aluminum heat sink.

Any long wavelength, ultraviolet light can be used to illuminate the surface, but Cascade Lasers' Lamp Model 22-UV is the most satisfactory. Its small size and high-illumination level permit it to be conveniently positioned out of the working area.

Display IR Laser Beams

No longer are the firebricks and smoldering paper "tools of the trade" for researchers working with CO₂ lasers. Now it is possible to see IR laser beams in real time and with high resolution using a Thermal Image Plate from Cascade Laser Corporation. The characteristics of this instrument enable to solve a wide range of problems. For example:

- The fast response time permits it to be used for viewing rapidly changing laser mode patterns when adjusting resonator mirrors.
- The convenient shape permits it to be placed next to optical elements to locate and center beams.
- The high resolution permits it to be used as a diagnostic tool to examine imperfections in IR optical elements or as an aide in optical alignment.

Even critical adjustment of a laser interferometer is greatly simplified when the interference fringes of two misaligned beams become clearly visible.

Description

The power density of CO₂ laser beams range from those which can rapidly burn holes in firebrick to those that can not be felt on the back of the hand. Eight different surfaces with overlapping sensitivities are used to smoothly span the power density range from 200 watts/cm² to 0.01 watts/cm². (The minimum detectable power for a focused beam is less than 0.001 watts.) Thermal Image Plate 22-A contains four surfaces which cover the power densities commonly obtained from CO₂ laser beams as they emerge from the laser. The lower power densities usually found in optical systems and divergent beams are covered by Thermal Plate 22-B.

The physical dimensions of each Thermal Plate (22-A and 22-B) are 6"x3-1/2"x1". Each side of these plates contain two sensitive surfaces which are 3"x3". The ultraviolet lamp (22-UV) measures 6"x2"x2".



CASCADE LASER CORP.

The table below gives the specifications of the eight surfaces measured at 8 to 12 microns. For use at 4 to 8 microns, multiply columns a, b and c by 2. For use at 2 to 4 microns, multiply columns a, b and c by 2.5.

Model Number	Surface Number	Normal Sensitivity Range (a) w/cm ²	Minimum Power Density (b) w/cm ²	Damage Threshold (c) w/cm ²	Response Time (d) sec.	Resolution (a) lines/in.	Fluorescent Color
22-A	1	60-200	16	800	<0.03	>300	green
	2	30-100	8	600	<0.03	>300	yellow
	3	15-50	4	350	0.03	300	yellow
	4	7.5-25	2	200	0.03	200	yellow
22-B	5	3.3-11	0.9	100	0.06	100	yellow
	6	1.5-5	0.4	44	0.15	50	yellow
	7	0.4-2.4	0.06	24	0.2	100	yellow
	8	0.06-0.4	0.01	4	1.0	16	yellow

- (a) The normal sensitivity range is the spread of power densities which can be easily viewed with no reduction in background illumination. The upper power density cutoff occurs when the surface becomes saturated, turning the area completely black and making it incapable of displaying any further detail within the beam.
- (b) The minimum-detectable power densities are the lowest power densities observable under the most favorable illumination levels. For this sensitivity the room lights must be dimmed and the level of ultraviolet illumination decreased to produce a dim fluorescence.
- (c) Damage threshold is the power density which produces a permanent change in the thermal-sensitive surface. This occurs at power factors at least four times greater than saturation. Therefore, when saturation occurs, a lower sensitivity surface should be used to display the beam.
- (d) The response time is the length of time it takes a change in the beam to be displayed as a change in the thermal image.
- (e) The resolution of a surface is the maximum number of dark and light line pairs which can be displayed with good contrast. For comparison, the resolution of a newspaper photograph is approximately 70 lines/inch. Two CO₂ laser beams intersection at an angle of two degrees produce an 80 line/inch interference pattern.

Power Dissipation

A Thermal Image Plate is capable of displaying beams up to 200 watts. However, it must be removed from the beam and allowed to cool when there is a marked decrease in overall fluorescence. This occurs when the plate has absorbed 15,000 watt seconds of power. Powers less than 30 watts can be dissipated indefinitely.

Safety

Precautions have been taken to eliminate specular reflections from the Thermal Image Plate. Both the thermal-sensitive surfaces and the anodized aluminum have matte finishes and show little surface reflection at 10.6 microns. However, standard safety precautions such as wearing protective glasses should always be observed when working with IR lasers.

Price

The Thermal Image Plates 22-A and 22-B as well as the ultraviolet lamp 22-UV can be purchased separately or together in the form of a Thermal Image Kit. When the kit is purchased, a hard plastic case is also included. Considering the wide range of power densities which can be obtained from nonuniform beams, we recommend an initial purchase of the Thermal Image Kit.

Ordering Information

Thermal Image Plate, Model 22-A

Thermal Image Plate, Model 22-B

Ultraviolet Lamp, Model 22-UV

Thermal Image Kit, Model 22-K (includes Model 22-A, 22-B, 22-UV, and a case)

Prices on custom thermal image surfaces are available upon request. These include larger sizes, models or coatings applied to supplied parts.



Figure 2: *Thermal Image Plates*

Contact Cascade Laser Corporation for ordering information or to request a quotation on any of these products.

Cascade Laser Corp.

101 N. Elliott Rd.

Newberg, OR 97132

Phone: 503-554-1926

Toll Free: 800-443-5561

Fax: 503-554-8285

E-mail: info@cascadelaser.com

Web: www.cascadelaser.com

*Thermal Image Plate
April 2001*